Cerebral revascularization techniques are essential components of cerebrovascular neurosurgery. External carotid artery (ECA) arterial pedicled donors are faster and safer than dual-anastomosis bypasses in patients with adequate flow. Several recent studies using intraoperative flow measurements have indicated that large diameter grafts are not always necessary to provide adequate flow to high-demand areas. The superficial temporal artery (STA), middle meningeal artery (MMA), and occipital artery (OA) are easily available ECA donors that can augment or replace flow to the anterior or posterior circulation.

Methods

The STA, MMA, and OA were dissected in 4 cadaveric specimens (8 sides). Frontotemporal, middle fossa, subtemporal, retrosigmoid, far-lateral, suboccipital, supracerebellar infratentorial, and occipital transtentorial approaches were performed on all sides. Depth of field, usable length, angle of exposure, diameter, proximal control, and maneuverability were quantified for all recipient vessels in each possible anastomotic configuration, as well as donor required length and diameter at the site of anastomosis.

Results

The internal carotid artery was exposed at the petrous and supracranial segments and STA and MMA anastomoses were analyzed. The middle cerebral artery was exposed in the sylvian fissure, and STA and MMA anastomoses were analyzed. All segments of the posterior cerebral artery were exposed using multiple approaches, and STA, MMA, and OA anastomoses were analyzed. The superior cerebellar artery was exposed by a combination of approaches and STA, MMA, and OA anastomoses were analyzed. The posterior inferior cerebellar artery anastomoses using the distal TM (8.2) and TV (8.5) segments to the OA (6.7 and 6.6) are optimal using a far lateral and suboccipital approach, respectively.

Conclusion

- Internal carotid artery: The MMA (5.6) scored equally to the STA (5.6) and should be considered for petrous ICA end-to-side anastomosis.
- Middle cerebral artery: While surgical exposure of M3 (9.0) is facilitated, the M2 (8.2) is optimally matched by size with the STA (8.1 vs. 6.9 when paired with M3).
- Posterior cerebral artery: A suboptimal recipient and should be avoided when possible, except P3 (5.5) to OA (6.4) using the supracerebellar-infratentorial approach. Superior cerebellar artery:
  - For all possible posterior circulation bypasses using the subtemporal approach, the LPM (6.8) is the only favorable recipient.
  - In the subtemporal approach the MMA (7.4) is the optimal donor and should be given strong consideration in addition to the STA (6.3).
- Posterior inferior cerebellar artery: Anastomoses using the distal TM (8.2) and TV (8.5) segments to the OA (6.7 and 6.6) are optimal using a far lateral and suboccipital approach, respectively.
- Vertebral artery:
  - The V3 (9.8) segment received the highest overall recipient score due to its superficial and extracranial location.
  - V3 to OA bypass received the highest combined score and likely represents the easiest overall anastomosis.